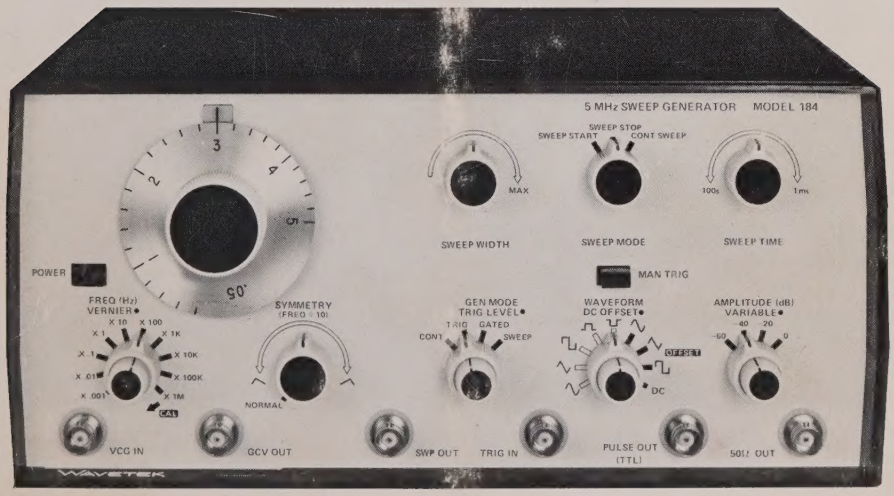
R255

MODEL 184
5 MHz SWEEP GENERATOR



WAVETEK

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MODEL 184
5 MHz
SWEEP GENERATOR

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SECTION 1
GENERAL DESCRIPTION

1.1 THE MODEL 184

Wavetek Model 184, the 5 MHz Sweep Generator, is a precision source of sine, triangle, square, positive pulse and negative pulse waveforms plus dc voltage. Frequency of the waveforms is manually and remotely variable from 100 μHz to 5 MHz.

The generator can repetitively sweep between two individually set frequencies and at a particular sweep rate. The amplitude of waveforms is variable from 20V p-p, open circuit maximum, to --80 dB.

DC reference of the waveforms can be offset positively and negatively.

The symmetry of the waveforms is continuously adjustable from approximately 1:19 to 19:1. Varying symmetry provides variable duty cycle pulses, sawtooth and asymmetrical sine waveforms.

A voltage representing generator frequency, a fixed-amplitude pulse train of that frequency, and a voltage ramp representing frequency sweep rate are provided as front panel outputs.

1.2 SPECIFICATIONS

Specifications (waveform, frequency, and amplitude selection), operating modes, precision (accuracy), and waveform purity (quality) are listed in the following paragraphs.

1.2.1 Versatility

Waveforms
Five selectable waveforms, sine ∿ , triangle △ , square ⊓ , positive pulse ⎍ , negative pulse ⎎ , plus variable DC output. Symmetry of all waveform outputs is continuously adjustable from approximately 1:19 to 19:1. Varying symmetry provides variable duty cycle pulses, sawtooth, or asymmetrical sine waveforms. Separate sync output is included.

Control
Frequency can be controlled manually, with external voltage (VCG) or with internally generated ramp voltage.

Operating Frequency Range
Frequency selectable from 0.0001 Hz to 5 MHz in the following linear ranges:

X 0.001	0.0001 Hz to 0.005 Hz
X 0.01	0.001 Hz to 0.05 Hz
X 0.1	0.005 Hz to 0.5 Hz
X 1	0.05 Hz to 5 Hz
X 10	0.5 Hz to 50 Hz
X 100	0.5 Hz to 500 Hz
X 1K	5 Hz to 5 kHz
X 10K	50 Hz to 50 kHz
X 100K	500 Hz to 500 kHz
X 1M	5 kHz to 5 MHz

NOTE

When SYMMETRY control is used, the output frequency is different from the dial indicated frequency. The maximum symmetry ratio obtainable is also dependent on the frequency dial setting.

Main Output
∿ , △ , ⊓ ; variable to 20V p-p into open circuit and 10V p-p into 50Ω load. DC offset of waveform (or DC if selected) is adjustable to ±10 volts open circuit and ±5 volts into 50Ω load.

⎍ , ⎎ , DC: 0 to +10 or −10 volts into open circuit and 0 to +5 or −5 volts into 50Ω load.

Output dc voltage is limited to approximately ±10 volt open circuit and output current is limited to approximately 130 mA.

Output can be attenuated from 0 dB to −80 dB: −60 dB in 20 dB steps, plus a 20 dB vernier for continuous variation (20 dB vernier does not affect offset or DC).

Pulse Output
Output voltage is TTL compatible. Rise and fall times are typically 15 ns. Sync is normally a symmetrical square waveform; with SYMMETRY control ON, it is rectangular.

Sweep Output
SWEEP OUT connector provides a nominal 0 to +5 volt (open circuit) ramp from a 600Ω source impedance.

DC Offset
DC offset of ∿ , ∿ , or ⊓⊔ waveform, or DC if selected, is adjustable to ±10 volts open circuit and ±5 volts into a 50Ω load. Output current is limited to approximately 130 mA. Waveform + offset is limited to ±10V into an open circuit.

GCV Output
A dc voltage proportional to the instantaneous frequency of the generator output. 0 to +5V, open circuit, 1 kΩ source impedance.

1.2.2 Operating Modes

Continuous
Operating as a standard VCG (voltage controlled generator), frequency output is determined by front panel control settings in conjunction with external control voltage at VCG IN.

Triggered
Only one complete cycle of output appears at 50Ω OUT connector for each pulse applied to TRIG IN connector (or press of MAN TRIG switch).

Gated
Same as triggered mode except that output oscillations continue for duration of gating signal applied to TRIG IN connector (or as the MAN TRIG switch is depressed).

Sweep
The internal ramp generator can sweep the main generator up in frequency with a linear ramp. The end frequency points may be individually set and the time for each ramp can be varied from 100s to 1 ms.

1.2.3 Voltage Controlled Generator

VCG Control Range: Up to 1000:1 frequency change with external voltage input.

Input Impedance: 5 kΩ.

VCG Voltage: 0 to ±5V.

VCG Slew Rate: 2% of range per μs.

VCG Linearity 0.0001 Hz to 50 kHz: ±0.5%.

1.2.4 Triggered Generator

Trigger pulse is 1V p-p to ±10V; input impedance is 10 kΩ, 33 pF; minimum pulse width is 50 μs; maximum repetition rate is 5 MHz.

1.2.5 Frequency Precision

Dial Accuracy (Symmetrical Waveform)
±2% of full scale for 0.005 Hz to 5 MHz.
±4% of reading and ±2% of full scale for 0.0005 Hz to 0.005 Hz.

Frequency Vernier
Approximately 1% of range. Vernier affects calibration of frequency dial.

Time Symmetry
±1% for 0.005 to 500 kHz.

1.2.6 Amplitude Precision

Amplitude Change With Frequency (Sine)
Less than ±0.1 dB to 100 kHz.
Less than ±0.2 dB to 1 MHz.
Less than ±1 dB to 5 MHz.

Step Attenuator Accuracy
±0.3 dB per 20 dB step.

Stability
Short Term: ±0.05% for 10 minutes.
Long Term: ±0.25% for 24 hours.

Percentages apply to amplitude, dc offset and main generator frequency in the linear mode.

Amplitude Symmetry
±1% of amplitude range to 1 MHz for all symmetrical waveforms.

1.2.7 Purity

Sine Distortion
Less than 0.5% for 10 Hz to 50 kHz.
Less than 1% for 0.005 500 kHz.
All harmonics at least 30 dB down for ×1 MHz range.

Triangle Linearity
Greater than 99% for 0.0005 Hz to 100 kHz.

Square Wave Rise and Fall Time
Less than 30 ns terminated into 50Ω load.

Square Wave Total Aberrations
Less than 5%.

1.2.8 Environmental

All specifications listed are for 25°C ±5°C. For operation from 0°C to 55°C, specifications including horizontal pre-

cision, amplitude symmetry, and sine wave distortion are derated by a factor of 2.

1.2.9 Mechanical

Dimensions
11¼ in./28.6 cm wide; 5¾ in./14.5 cm high; 10¾ in./27.3 cm deep.

Weight
8.5 lb/3.8 kg net; 12 lb/5.5 kg shipping.

1.2.10 Power

90V to 110V, 105V to 125V, 180V to 220V or 210V to 250V; 50 Hz to 400 Hz; less than 25 watts.

NOTE

Specifications apply from 10 to 100% of a selected frequency range with SYMMETRY control OFF.

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SECTION 2
INITIAL PREPARATION

2.1 UNPACKING INSPECTION

After carefully unpacking the instrument, inspect the external parts for damage to knobs, dials, indicators, surface areas, etc. If there is damage, file a claim with the carrier who transported the instrument. Retain the shipping container and packing material for use in case reshipment is required.

2.2 PREPARATION FOR USE

Before connecting the instrument to line power, be sure the rear panel 115/230V and HI/LO switches are set to the value nearest the line voltage and that the fuse is correct for the switch setting. Be sure that the plug on the power cord is the proper mate for the line receptacle.

AC Line Voltage	Switch A	Switch B	Fuse (SB)
90 - 110	115	LO	1/4 amp
105 - 125	115	HI	1/4 amp
180 - 220	230	LO	1/8 amp
210 - 250	230	HI	1/8 amp

2.3 ELECTRICAL ACCEPTANCE CHECK

This checkout procedure verifies the generator operation. If a malfunction is found, refer to the Warranty in the front of this manual. An oscilloscope, 50Ω coax cable and 50Ω feedthru are needed for this procedure (figure 2-1).

Preset the generator front panel controls as follows:

Control	Position
GEN MODE	CONT
WAVEFORM	∿
SYMMETRY	NORMAL
FREQ Range	X 1K
FREQ VERNIER	CAL
Frequency Dial	1
AMPLITUDE	0 dB
AMPLITUDE VARIABLE	Full clockwise
DC OFFSET	12 o'clock
TRIG LEVEL	Full counterclockwise
SWEEP MODE	CONT SWEEP
SWEEP WIDTH	MAX
SWEEP TIME	12 o'clock

Perform the steps in table 2-1. Only approximate values are required to verify operation.

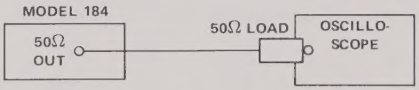


Figure 2-1. Acceptance Test Setup

Table 2-1. Performance Checkout

Step	Control	Position/Operation	Observe at 50Ω OUT
	Function		
1	POWER	Push on	Sine wave, 1 kHz, 10V p-p
2	WAVEFORM	∿	Triangle wave
3	WAVEFORM	⊓	Square wave
4	WAVEFORM	⎍	Positive pulse
5	WAVEFORM	⊔	Negative pulse

Performance Checkout (Continued)

Step	Control	Position/Operation	Observe at 50Ω OUT
6	SYMMETRY	cw	Frequency ÷ 10, decreasing negative pulse width
7	SYMMETRY	ccw	Decreasing positive pulse width
8	SYMMETRY	NORMAL	– – –
9	WAVEFORM	∿ (OFFSET)	Sine wave, 1 kHz
	Frequency		
10	FREQ Range	X 1M	Frequency = 1 MHz
11	FREQ VERNIER	ccw	Frequency decreases by at least 50 kHz
12	FREQ VERNIER	CAL	– – –
13	FREQ Range	X .001	Detect generator running
14	FREQ Range	X 1K	– – –
15	Frequency Dial	5	Frequency = 5 kHz
16	Frequency Dial	.05	Frequency = 50 Hz
17	Frequency Dial	1	– – –
	Amplitude		
18	AMPLITUDE Range	–60 dB	10 mV p-p
19	AMPLITUDE VARIABLE	ccw	1 mV p-p
20	AMPLITUDE Range	0	1V p-p
21	DC OFFSET	cw	Positive slew; about +5V positive peak
22	DC OFFSET	ccw	Negative slew; about –5V negative peak
23	WAVEFORM	∿ (No OFFSET)	Triangle wave
	Trigger & Gate		
24	GEN MODE	TRIG	0 Vdc
25	MAN TRIG	Push	Generate one cycle
26	GEN MODE	GATED	0 Vdc
27	MAN TRIG	Push and hold	Continuous ∿ waveforms

Performance Checkout (Continued)

Step	Control	Position/Operation	Observe at 50Ω OUT
28	MAN TRIG	Release	0 Vdc
	Sweep		
29	GEN MODE	SWEEP	Frequency sweeps
30	SWEEP TIME	cw	Sweep rate increases
31	SWEEP TIME	ccw	Sweep rate decreases

Disconnect the cable at 50Ω OUT and connect it to SWP OUT: observe a 5 V ramp waveform. Connect it to GCV OUT: observe a ramp plus dc. Connect it to PULSE OUT: observe a 2.4 V positive pulse.

SECTION 3
OPERATION

3.1 CONTROLS AND CONNECTORS

The generator front panel controls and connectors are shown in figure 3-1 and keyed to the following descriptions:

(1) POWER Switch

Power is turned on and off with the POWER push-button. The frequency dial index (1A) lights when power is turned on.

(2) Frequency Dial

Frequency settings of the dial multiplied by frequency range (18) determine output frequency. In frequency sweep operation, this dial determines the frequency from which sweep is started.

(3) SWEEP WIDTH Control

The SWEEP WIDTH control determines the amount of frequency change that will occur in sweep mode. After the sweep start frequency is set by the frequency dial, SWEEP WIDTH determines the sweep stop frequency (see figure 3-2).

(4) SWEEP MODE Selector

The SWEEP MODE selector is enabled by the GEN MODE selector (14) set to SWEEP. After the start frequency of the generator is determined by the frequency dial (2), the stop frequency is determined by the SWEEP WIDTH control (3). The SWEEP START and SWEEP STOP settings will hold the output signal at the start and stop

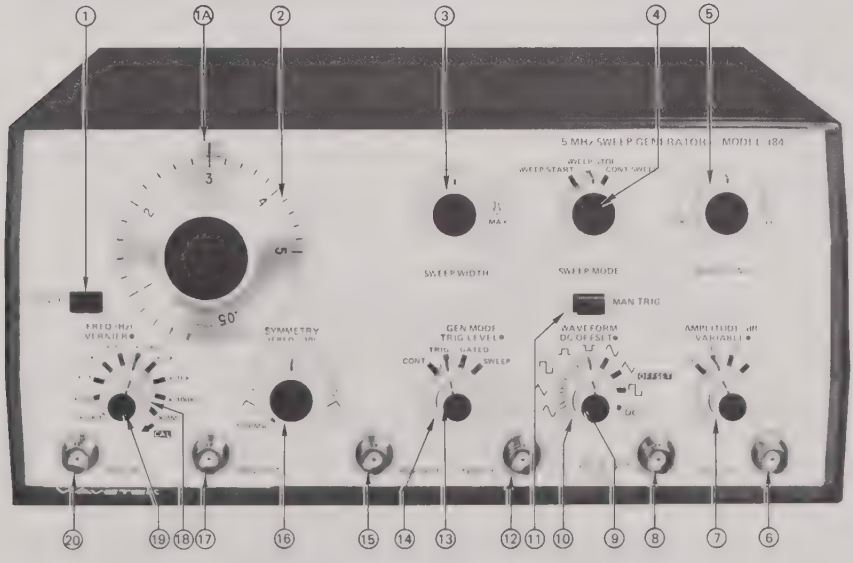


Figure 3-1. Front Panel Controls and Connectors

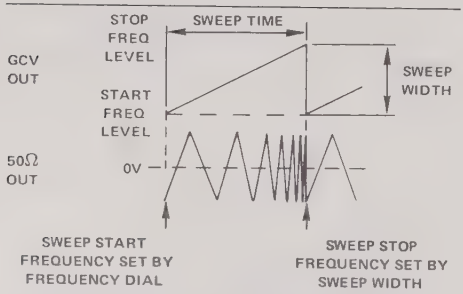


Figure 3-2. Effect of Sweep Time and Width on Output Frequency

frequencies, respectively, while the frequency dial (2) and SWEEP WIDTH control (3) are adjusted. CONT SWEEP allows frequency sweeping between the two set limits.

(5) SWEEP TIME Control

Frequency of the internal sweep ramp, and thus, the sweep repetition rate, is governed by the SWEEP TIME control (see figure 3-2).

(6) Main Output Connector

Maximum output of 10V p-p signals into a 50Ω load (20V p-p open circuit) is provided at the 50Ω OUT connector; all generator mode signals are delivered at this connector. See (7) for amplitude of output.

(7) AMPLITUDE Control

The AMPLITUDE switch affects waveforms, dc output and waveform dc offset. The VARIABLE control affects waveforms only. Maximum waveform amplitude is with the 0 dB setting of the AMPLITUDE control and with the VARIABLE control fully cw (see table 3-1). Amplitude is decreased 20 dB with VARIABLE control fully ccw.

Table 3-1. Maximum Voltage at 0 dB

Function	Open Circuit	50Ω Termination
∿ , ⊓	20V p-p	10V p-p
⎍	0 to +10V	0 to +5V
⎎	0 to −10V	0 to −5V
DC	±10V	±5V

(8) Synchronizing Pulse Output Connector

A fixed amplitude (0 to about 5V) TTL pulse of the generator frequency is provided at the PULSE OUT connector. This output can be used as a synchronizing reference for the main output (6). Phase of the waveforms relative to the sync output is shown in figure 3-3.

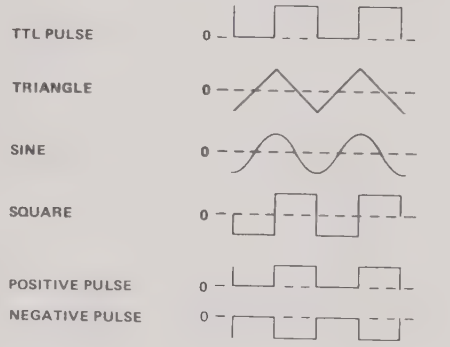


Figure 3-3. Pulse/Waveform Phase Relationship and Waveform Reference Lines

(9) DC OFFSET Control

Offset of waveforms and dc voltage are controlled by the DC OFFSET control. The WAVEFORM switch (10) must be in one of the four right-hand settings. Center of the waveform reference (figure 3-3) is skewed positive with clockwise rotation, negative with counterclockwise rotation. Offset and dc voltage maximums are ±5V (50Ω terminated).

(10) WAVEFORM Selector

Sine ∿ , triangle ∿ , and square ⊓ waveforms, and positive and negative square pulse trains ⎍ , ⎎ are selected for output by the WAVEFORM selector, with or without dc offset. When set for dc offset, the inner knob (9) controls the ±5V (50Ω terminated) offset. DC is selected for dc output with voltage controlled by the inner knob (9).

(11) Manual Trigger Control

In TRIG mode (14), the MAN TRIG pushbutton is used to trigger a single cycle of waveform output

and, in the GATED mode, to gate the output of waveforms until released.

NOTE

The TRIG LEVEL control (13) must be fully CCW.

(12) **Remote Trigger Input Connector**

The TRIG IN connector accepts voltage level inputs that trigger and gate the generator in TRIG and GATED modes (14), respectively. The trigger level control (13) determines the level at which the TRIG IN input is accepted for triggering or gating. A positive-going excursion through a voltage level, which can be set in the range of −7.5V to +7.5V by the TRIG LEVEL control triggers or gates the generator operation.

A negative-going dc excursion through the trigger level ends gated operation. Figure 3-4 shows triggering and gating of the generator waveforms at time t1. Once triggered or gated, a full cycle of the selected waveform is output to its completion: when gating is removed at time t2, for example, the last full cycle of waveform completes itself at time t3.

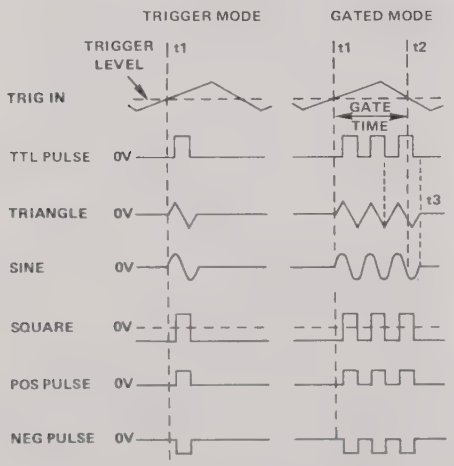


Figure 3-4. Generator Trigger and Gated Control

(13) **Trigger Level Control**

The TRIG LEVEL control determines the level at which the input at the TRIG IN connector (12) is accepted as a trigger in the generator trigger and gated modes (14). The trigger level can be varied from fully clockwise, where a positive-going excursion thru −7.5V is a trigger, to fully counterclockwise, where a positive-going excursion thru +7.5V is a trigger.

(14) **Generator Mode Selector**

Generator modes are:

1. Continuous – An uninterrupted output of the selected waveform at the selected frequency and amplitude.

2. Triggered – One cycle of the selected waveform at the selected frequency and amplitude when the trigger signal is detected at TRIG IN (12) or when manually triggered at (11).

3. Gated – A burst of the selected waveform at the selected frequency and amplitude, which starts when the gate signal is detected at TRIG IN (12) and lasts through the completion of the last cycle started before the removal of the gate signal, or starts and stops when manually gated at (11).

4. Automatically Swept Frequency – Sweep as determined by the SWEEP MODE control (4).

(15) **Sweep Ramp Output Connector**

The internal sweep generator ramp is available at the SWP OUT connector. Ramp frequency is varied by the SWEEP TIME control. Output is a 0 to +5V ramp, 600Ω source impedance.

(16) **Waveform SYMMETRY Control**

Normal symmetrical output results when SYMMETRY is set to NORMAL; an asymmetrical, or unbalanced, waveform results when SYMMETRY is set between ◺ and ◿. (Asymmetric operation reduces generator frequency to approximately 1/10th the normal output.) Figure 3-5 shows the effect of SYMMETRY control on the waveforms.

NOTE

When SYMMETRY control is used, the output frequency is different from the dial indicated frequency. The maximum symmetry ratio obtainable also depends on the frequency dial setting. A typical example is shown in table 3-2.

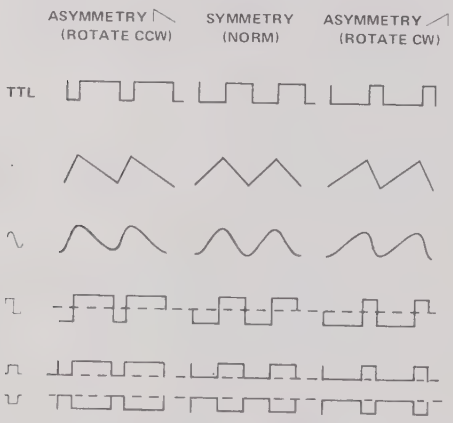


Figure 3-5. Effect of SYMMETRY Control

⑰ **GCV Output Connector**

GCV OUT provides dc excursions of 0 to about +5V which represent the output frequency in the selected range. Source impedance is 1 kΩ.

⑱ **Frequency Range Control**

The selected range settings of the FREQ selector, multiplied with the frequency dial ② setting determine output frequency.

⑲ **Frequency VERNIER Control**

The frequency is as labeled on ⑱ and ②, when the VERNIER control is set fully clockwise to CAL (calibrated). Rotating the VERNIER control counterclockwise decreases output frequency. The range is approximately 1% of the selected frequency range.

⑳ **VCG Input Connector**

DC voltage excursions of 0 to ±5 volts at the VCG IN connector control frequency within the selected range. Positive inputs increase frequencies set by the frequency dial ② and range control ⑱, and negative inputs decrease the frequencies. Input impedance is 5 kΩ. Frequency excursions of 1000:1 are possible.

3.2 OPERATION

Operation is discussed in terms of the four generator modes: continuous, triggered, gated and sweep plus VCG.

3.2.1 Signal Termination

Proper signal termination, or loading, of the generator connectors is necessary for its specified operation. For example, the proper termination of the main output is shown in figure 3-6. Placing the 50Ω terminator, or 50Ω resistance, in parallel with a higher impedance matches the receiving

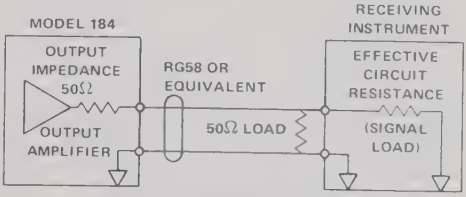


Figure 3-6. Signal Termination

Table 3-2. Dial Setting

Frequency Range	X 100K					
Dial Setting	5	4	3	2	1	0.5
Indicated Frequency	500 kHz	400 kHz	300 kHz	200 kHz	100 kHz	50 kHz
Output Frequency	54 kHz	44 kHz	33 kHz	23 kHz	12 kHz	6.5 kHz
Maximum Symmetry Ratio	18:1	18:1	18:1	17:1	16:1	15:1

instrument input impedance to the generator output impedance, thereby minimizing signal reflection or power loss on the line due to phase angle mismatch.

The input and output impedance of the generator connectors are listed below:

Connector	Impedance
50Ω OUT	50Ω
TRIG IN	10 kΩ
PULSE OUT (TTL)	*
SWP OUT	600Ω
VCG IN	5 kΩ
GCV OUT	1 kΩ

*The PULSE OUT connector can drive up to 20 Transistor-Transistor Logic (TTL) loads (low level between 0V and 0.4V, and high level between 2.4V and 5V).

3.2.2 Continuous Operation

Basic, or continuous, operation of the generator involves turning on power, selecting a continuous output mode, selecting a waveform, and setting the output signal frequency and amplitude. When operation is critical, allow a one-half hour warm-up period. The following steps demonstrate use as a basic function generator:

Step	Control/Connector	Setting
1	50Ω OUT	Connect circuit (refer to paragraph 3.2.1).
2	PULSE OUT	Use for external synchronization, if required.
3	GEN MODE	CONT
4	WAVEFORM	Choose one of the left-hand set of waveforms. If dc or dc offset is desired, use right-hand set.
5	SYMMETRY	NORMAL or desired asymmetry. (Affects frequency calibration.)
6	FREQ	As desired for frequency range.
7	Frequency Dial	As desired for exact frequency.
8	FREQ VERNIER	CAL, unless extreme frequency accuracy is required, in which case, monitor with a frequency counter.
9	AMPLITUDE	As desired.
10	AMPLITUDE VARIABLE	As desired.
11	DC OFFSET	As desired (step 4, right-hand set of waveforms must be chosen). CW positive offset, ccw negative offset. See figure 3-7 for restrictions.

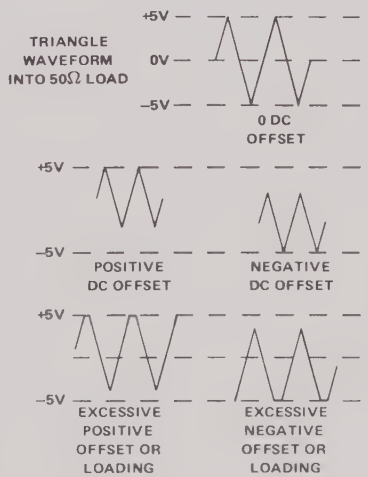


Figure 3-7. DC OFFSET Control

3.2.3 Trigger Mode

Operation as a triggered one cycle generator is as for a basic function generator, only the operating mode is triggered (TRIG) instead of continuous (CONT), and a manual or remote trigger (MAN TRIG, TRIG IN) is used to start the single cycle of waveform. Perform the steps given in paragraph 3.2.2, only set the GEN MODE control in step 3 to TRIG. Refer to paragraph 3.2.4 for triggering.

NOTE

The signal at SWP OUT can be used as source of repetitive trigger inputs.

within a particular range is additionally controlled with dc levels within ±5V, injected at the VCG IN connector. Perform the steps given in paragraph 3.2.2, only set the frequency dial to determine a reference from which the frequency is to be voltage controlled:

1. For frequency control with positive dc inputs at VCG IN, set the dial for a lower limit from which frequency is to be increased.

2. For frequency control with negative dc inputs at VCG IN, set the dial for an upper limit from which frequency is to be decreased.

3. For modulation with an ac input at VCG IN, set the dial at the desired center frequency. Do not exceed the maximum dynamic range of the selected frequency range.

Figure 3-8 is a nomograph with examples of the frequency dial effect as a reference for VCG IN voltages. Example 1 shows that with 0V VCG input (2nd column), frequency (3rd column) is as determined by the frequency dial setting of 2 (1st column). Example 2 shows that with a positive VCG input, output frequency is increased. Example 3 shows that with a negative VCG input, output frequency is decreased. (Note that the Factor of 50Ω OUT Frequency column must be multiplied by the frequency range in order to give the actual 50Ω OUT frequency.) For full 1000:1 linear mode VCG sweep of the generator frequencies, set the FREQ VERNIER full ccw.

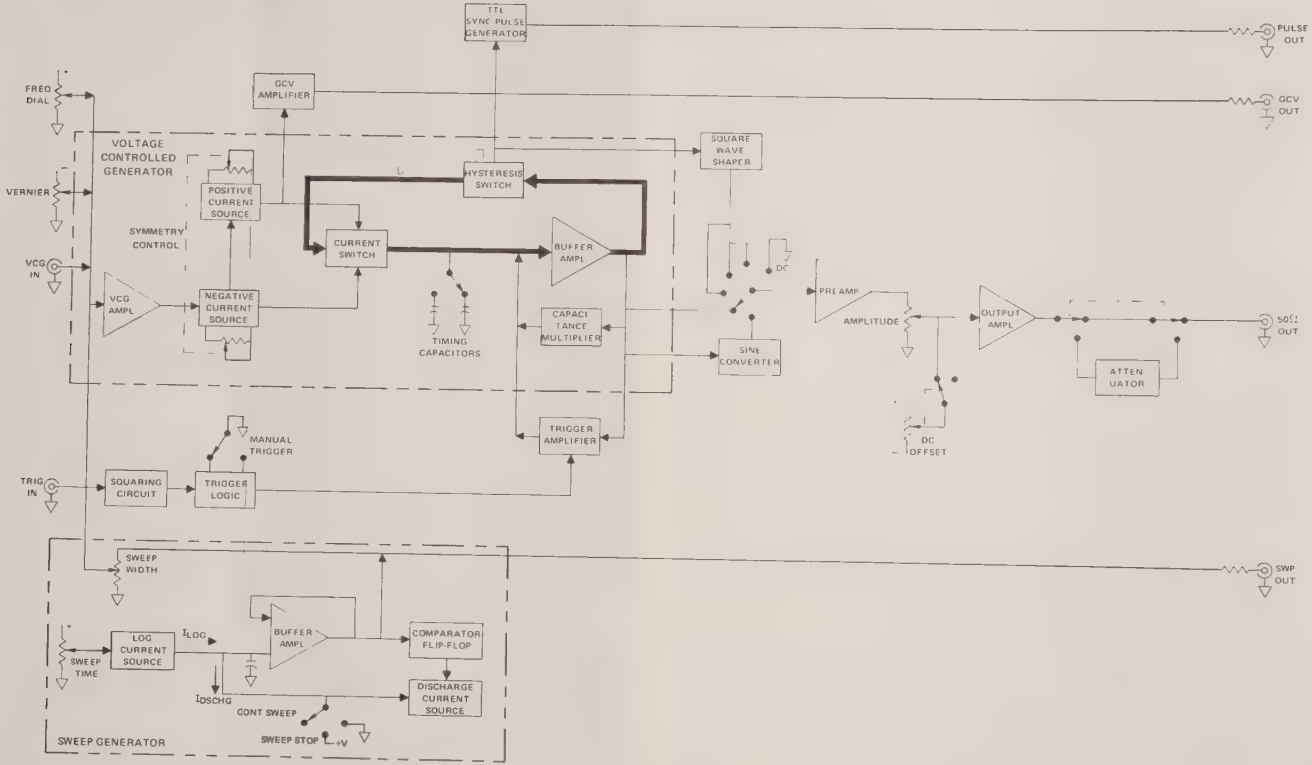


Figure 4-1. Simplified Block Diagram

SECTION 4
CIRCUIT DESCRIPTION

4.1 VOLTAGE CONTROLLED GENERATOR

The heart of the generator consists of the positive and negative current sources, the current switch, timing capacitors, triangle amplifier, and hysteresis switch (figure 4-1).

The positive and negative current sources generate equal but opposite polarity currents which charge and discharge the timing capacitor selected by the range selector. The current switch, which is controlled by the hysteresis switch, selects either the positive or the negative current as the input to the capacitor. Since the capacitor is being charged by a current source which changes polarity periodically, the voltage across the capacitor forms a triangle waveform. This waveform is fed through the triangle buffer amplifier to the hysteresis switch. The hysteresis switch determines when the triangle waveform reaches predetermined positive and negative peak values. When this occurs, the output of the hysteresis changes state and causes the current switch to select the opposite polarity current. The output of the hysteresis switch is a square wave whose edges correspond to the triangle peak values.

The magnitude of the current produced by the current sources is dependent upon the output of the VCG amplifier. By varying the output of the VCG amplifier, the frequency of the triangle and square waveforms may be controlled.

In order to generate sine waves, the triangle waveform is sine shaped in the sine converter circuit with nonlinear elements. The waveform switch selects the waveform of interest and a portion of the signal is selected by the amplitude potentiometer and applied to the output amplifier. The output amplifier is capable of driving a 50Ω load and may be dc offset. The amplifier output is routed to a 50Ω attenuator which can provide 60 dB of attenuation in 20 dB steps. An additional 20 dB of attenuation can be obtained from the amplitude control.

The square wave from the hysteresis switch is also applied to the TTL sync pulse generator, whose square wave output is TTL compatible.

To change frequency ranges, different timing capacitors may be selected by the frequency range switch. On the very slow frequencies the capacitance multiplier becomes active. This circuit senses the capacitor charging current and then subtracts a certain percentage of it from the capacitor. As a result, the capacitor does not charge as fast, and the frequency, as a result, is lower.

Several things can affect the frequency of the generator by varying the output of the VCG amplifier. One is the frequency dial of the function generator which feeds a voltage to the VCG amplifier. In addition to the frequency dial, the frequency vernier feeds in a voltage to the VCG amplifier. The range of the vernier is approximately 1% of the full scale frequency. Finally, an external voltage applied to the VCG input can control the frequency of the generator loop. The VCG input allows frequency modulation of the generator by an external signal.

Under normal conditions the generator loop runs with the positive and negative current sources balanced. This results in symmetrical sine, triangle and square waveforms, or in the case of the square waveform, a duty cycle of 50%. By varying the symmetry control, the current sources may be unbalanced which results in the generation of asymmetrical waveforms. This allows the generation of pulses, ramps, and other waveshapes.

In the trigger mode, the generator is stopped by the trigger amplifier. This amplifier compares the output of the triangle amplifier to ground. Its output draws just the right amount of current away from the capacitor to keep it at zero volts. This level is known as the trigger baseline. When an external signal is applied to the trigger input, it is shaped into a fast rise time pulse by the squaring circuit and is applied to the trigger logic circuit. This circuit in turn shuts off the trigger amplifier for one cycle of the output waveform. Trigger input may also be made manually by the manual trigger switch.

The trigger logic circuit also allows the generator to run in the gated mode. In this mode the generator will run as long as the trigger input signal is positive. When it goes negative, the generator will continue to run until the last cycle is complete and then remain at the trigger baseline level.

The GCV output is an analog output voltage proportional to the instantaneous output frequency of the generator. This is from the GCV amplifier which senses the positive

current source output and generates a voltage proportional to the current.

4.2 SWEEP GENERATOR

The internal sweep generator can frequency modulate the main generator. It generates a positive-going linear ramp signal which can be controlled in both period and amplitude. This signal is added to that of the main frequency dial and is applied to the VCG amplifier. This results in a linearly increasing FM sweep.

The linear sweep ramp is obtained by charging the capacitor with a constant current from the log current source. When the positive peak of the ramp reaches a predetermined value, the comparator turns on the discharge current source and quickly discharges the capacitor to zero volts. When this point is reached, the comparator resets and turns off the discharge current source. A new ramp cycle now begins.

The buffer amplifier provides a high input impedance to the capacitor, thus assuring a highly linear ramp. It also provides the power required to drive the main generator VCG circuit.

The log current source has a built-in log converter circuit which allows a single sweep rate control to provide sweep rates of 1 ms to 100s: a 10^5 control range.

A sweep output signal can drive X-Y recorders or other devices.

SECTION 5
CALIBRATION

5.1 FACTORY REPAIR

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

5.2 REQUIRED TEST EQUIPMENT

Spectrum Analyzer . . . . . 600 kHz to 5 MHz
Voltmeter . Microvolt dc measurement (0.01% accuracy)
Oscilloscope, Dual Channel . . . 150 MHz bandwidth
Distortion Analyzer . . . . . To 600 kHz
Counter . . . . . To 10 MHz (0.1% accuracy)
50Ω Load . . . . . ±0.1% accuracy

5.3 REMOVING GENERATOR COVER

For main circuit board access, invert the instrument, remove the four screws in the cover, and lift off the bottom cover.

5.4 CALIBRATION

After referring to the following preliminary data, perform calibration, as necessary, per table 5-1. If performing partial calibration, check previous settings and adjustments for applicability.

1. Unless otherwise noted, all measurements made at the 50Ω OUT connector should be terminated into a 50Ω (±0.1%) load.

2. Test Points (TPs) and adjustments are on the main board unless noted otherwise.

3. Before connecting the unit to an ac source, check the ac line circuit to make sure the 115/230 and HI/LO switches are set at the correct position (see paragraph 2.2).

4. Start the calibration by setting the front panel switches as follows:

FREQ Range . . . . . X 10K
Frequency Dial 5
FREQ VERNIER. . . . . CAL
SYMMETRY . . . . . NORMAL
GEN MODE . . . . . CONT
WAVEFORM . . . . . ⎍ (No Offset)
AMPLITUDE 0
AMPLITUDE VARIABLE. . . . . Max cw
SWEEP MODE . . . . . SWEEP START
SWEEP TIME 100s

5. Allow the unit to warm up at least 30 minutes for final calibration.

Table 5-1. Calibration Chart

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
1	Power Supply Regulators	Voltmeter	C84 (+)	—	R206	+15 Vdc ±50 mV	Ground is C84 (—).
2			C88 ( )			—15 Vdc ±150 mV	
3			C80 (+)			+5V ±250 mV	
Cover the instrument and allow a 30 minute warm-up. Keep covered as much as possible during calibration.							
4	Amplifier Offset	Voltmeter	Q19 emitter	GEN MODE: TRIG WAVEFORM: ∿	R192	0V ±5 mV	∿ amplifier output.

Table 5-1. Calibration Chart (Continued)

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
5	Amplifier Offset	Voltmeter	50Ω OUT		R124	0V ± 10mV	
6				AMPLITUDE VARIABLE: max ccw	R156		Repeat steps 5 and 6
7	Time Symmetry	Dual channel scope		GEN MODE: CONT WAVEFORM: ⊓ FREQ: X 1K Dial: 5 Scope time base: 20 μs/div	R324	Time symmetry < 0.1%	Follow procedure in figure 5-1.
8				FREQ: X 100K Dial: .05	R35 3		Follow procedure in figure 5-1.
9							Repeat steps 6 and 7.
10	VCG Zero			Same as for step 7	R13	Minimum frequency shift while shorting and opening VCG IN BNC to ground	
11	Sine Distortion	Distortion analyzer (with 50Ω termination)		FREQ: X 1K VERNIER: CAL Dial: 5 WAVEFORM: ∿	R68, 1 R71 2 REF. TO PREV. DIST. LVL'S.	Distortion < 0.16%	If minimum distortion cannot be met, refer to table 6-1.
12				Dial: 1	UP TO < DIST. OK) — G.C.	Distortion < 0.2%	If adjustment was necessary, repeat step 10.
13				FREQ: X 10K			
14	High Freq Sine Distortion			FREQ: X 1M Dial: 1 WAVEFORM: ⊓	C64	Minimum rise time with minimum overshoot	
15		Spectrum analyzer		WAVEFORM: ∿	None	All harmonics below −32 dB from 1 to 5 MHz	If not, refer to table 6-1.
16	Frequency	Counter		WAVEFORM: ⊓ FREQ: X 10K Dial: 5	R21	50 kHz ±100 Hz	
17				FREQ X 1M	C22	5 MHz ±20 kHz	Repeat steps 15 and 16.
18				FREQ: X 100K	C17	500 ±1 kHz	Change C16 if necessary

Table 5-1. Calibration Chart (Continued)

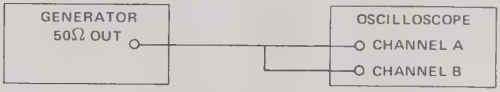
Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
19	Frequency	Counter	50Ω OUT	FREQ: X 100	None	500 ±10 Hz	
20				FREQ: X 1K		5 kHz ±100 Hz	
21				FREQ: X 10K		50 ±1 kHz	
22	Time Symmetry	Dual channel scope		FREQ: X 10 Scope time base: 0.1s/div	R92	Time symmetry < 0.1%	Follow procedure in figure 5-1.
23	Frequency	Counter		Dial: 5	R88	50 ±0.1 Hz or 20 ms ±40 μs	Change R87 if necessary.
24				FREQ: X .001	None	5 mHz ±0.3 mHz 189s to 217s.	
25				FREQ: X .01		.05 Hz ± 1 mHz or 20s ± 400ms	
26				FREQ: X .1		0.5 Hz ± 10mHz or 2s ± 40ms	
27				FREQ: X 1		5 Hz ± 100mHz or 0.2s ± 4ms	
28				FREQ: X 1K Dial: 5, 4, 3, 2, 1, .5		Dialed Freq ±100 Hz	
29				FREQ: X 1M Dial: .5, 1, 2, 3, 4, 5		Dialed Freq ± 100kHz	

Remove the four screws attaching the main board to the long standoffs. Put the bottom cover on, but do not insert the screws. Place the instrument on its feet and remove the top cover for sweep board access.

30	Sweep	Oscilloscope	SWP OUT	SWEEP MODE: CONT SWEEP			With SWEEP TIME, set SWP OUT to near 100 Hz. Alternate SWEEP MODE between CONT SWEEP and SWEEP STOP while performing step 31.

Table 5-1 Calibration Chart (Continued)

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
31	Sweep	Oscilloscope	SWP OUT	No change	Sweep board R12	CONT SWEEP amplitude = SWEEP STOP amplitude ±10 mV	

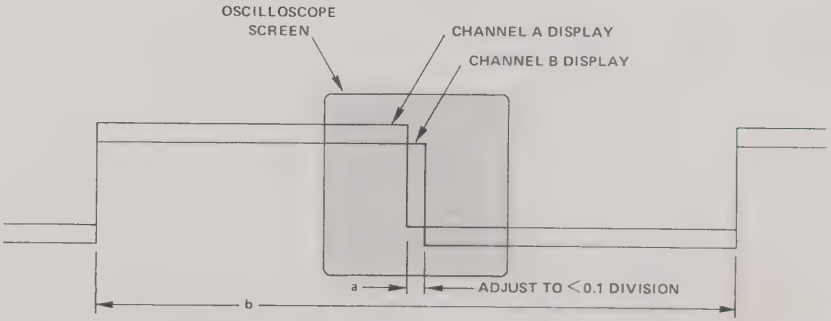


1. ADJUST OSCILLOSCOPE.

   TRIGGER: INTERNAL AND ALTERNATE
   CHANNEL A: NORMAL
   CHANNEL B: INVERTED

2. ADJUST FREQUENCY DIAL/VERNIER FOR ONE CYCLE ON SCOPE.

3. SWITCH X 10 SWEEP MAGNIFIER ON.



TIME SYMMETRY = 100 a/b%
SPECIFICATION: ±0.1%

Figure 5-1. Time Symmetry Measurement

SECTION 6
TROUBLESHOOTING

6.1 INTRODUCTION

This section is organized as follows:

Circuit Board Access
Basic Techniques
Troubleshooting Individual Components
Troubleshooting Guide

(Refer to paragraph 5.2 for required test equipment.)

NOTE

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

6.2 CIRCUIT BOARD ACCESS

Turn the instrument over, remove the four screws in the bottom cover and remove the bottom cover. For sweep board access, remove the four screws holding the main board to its long standoffs, place the instrument right side up and remove the top cover.

6.3 BASIC TECHNIQUES

Troubleshooting requires no special technique. Listed below are a few reminders of basic electronic fault isolation.

1. Check control settings carefully. Many times a seemingly malfunction is an incorrect control setting, or a knob that has loosened on its shaft.

2. Check associated equipment connections. Make sure that all connections are securely connected to the correct connector.

3. Perform the calibration procedure. Many out-of-specification indications can be corrected by performing specific calibration procedures.

4. Visually check the interior of the instrument. Look for such indications as broken wires, charred components, and loose leads.

6.4 TROUBLESHOOTING INDIVIDUAL COMPONENTS

6.4.1 Transistor

A transistor is defective if more than one volt is measured across its base emitter junction in the forward direction.

A transistor when used as a switch may have a few volts reverse bias voltage.

If the collector and emitter voltages are the same, but the base emitter voltage is less than 500 mV forward voltage (or reversed bias), the transistor is defective.

A transistor is defective if its base current is larger than 10% of its emitter current (calculate currents from voltage across the base and emitter series resistors).

6.4.2 Diode

A diode is defective if there is greater than 1 volt (typically 0.7 volt) forward voltage across it (except Zener and LED).

6.4.3 Operational Amplifier

The "+" and "–" inputs of an operational amplifier will have less than 15 mV voltage difference when operating under normal conditions.

If the output voltage stays at maximum positive, its "+" input voltage should be more positive than its "–" input voltage, or vice versa; otherwise, the operational amplifier is defective.

6.4.4 FET Transistor

No gate current should be drawn by the gate of an FET transistor. If so, the transistor is defective.

The gate-to-source voltage is always reverse biased under a normal operating condition; e.g., the source voltage is more positive than the gate voltage for 2N5485, and the source

voltage is more negative than gate voltage for a 2N5462. Otherwise, the FET is defective.

6.4.5 Capacitor

Shorted capacitors have zero volts across their terminals.

Opened capacitor can be located (but not always) by using a good capacitor connected in parallel with the capacitor under test and observing the resulting effect.

6.5 TROUBLESHOOTING GUIDE

Table 6-1 provides a list of possible malfunction symptoms, their probable causes, and the prescribed remedies. Localize the fault to a specific stage by checking the parameters given for the test points. Then check the dc operating voltages at the pins of solid-state devices. Check associated passive elements with a high input impedance ohmmeter (power off) before replacing a suspected semiconductor element.

Table 6-1. Troubleshooting Guide

Symptom	Corrective Procedures
POWER SUPPLY PROBLEM	
Blown fuse	1. Check that the HI/LO and 115/230 switches at the rear panel are set correctly. (Refer to paragraph 2.2.) 2. Replace fuse; if fuse blows again, refer to the following steps. 3. Examine circuit boards and wiring for source of short circuit. 4. Use an ohmmeter to detect possible short circuits between power supply and ground and between individual power supplies. 5. Isolate each part of the circuit by unplugging the sweep board and unsoldering the jumpers along the power supply path. Plug in the sweep board and replace the jumpers one-by-one to isolate the overloading circuit. Frequently, a shorted capacitor is the problem.
±15V supply voltage below normal	Isolate the power supply from most of the generator circuits by unsoldering the two jumpers near the "+" end of C81 on the main circuit board. If supply voltage returns to normal, there is an extra loading current from a generator circuit; otherwise, troubleshoot the power supply circuitry.
±15V supply voltage above normal	Power supply circuit malfunction.
+5V regulator voltage abnormal	Isolate the regulator from generator circuits by unsoldering any leads at E15, E16 and E17. If regulator voltage returns to normal, there is an extra loading current from a generator circuit; otherwise, the trouble is in the regulator. Replace IC10.
Index (lighted indicator) on front panel abnormally bright or dim	HI/LO switch at the rear panel is not set correctly. (Refer to paragraph 2.2.)
OUTPUT WAVEFORM PROBLEM	
No output waveform at 50Ω OUT and PULSE OUT (GEN MODE at CONT)	1. Ensure power supply voltages are normal. 2. Temporarily remove Q44 on main board. If generator runs, problem is in the trigger and gate logic circuit. Otherwise, trouble is in the generator loop.

Table 6-1. Troubleshooting Guide (Continued)

Symptom	Corrective Procedures
No output waveform at 50Ω OUT, but PULSE OUT normal, or all waveforms greatly distorted	Set the AMPLITUDE VARIABLE full ccw and set WAVEFORM to DC. If the output voltage at 50Ω OUT can be adjusted to ±10V into open circuit with the DC OFFSET control, the problem is in the preamplifier; otherwise, check the output amplifier.
Both waveform amplitude and frequency jittering	1. Power supply out of regulation due to ac line voltage being too low. Check line voltage. Make sure the HI/LO switch setting on rear panel is correct. (Refer to paragraph 2.2.) 2. Power supply malfunction. (Refer to Power Supply Problem.)
Distorted sine and square waveforms, but triangle waveform normal	Sine converter and square shaper malfunction. Check for defective diode. *NOTE* *If a diode is bad, the entire set of eight diodes should be replaced with a new matched set, or select a diode that gives minimum sine distortion at 1 kHz.*
Half of sine and square waveforms missing	1. Defective diodes CR17 or CR21. 2. Defective switch wafer or loose contact of SW3-A and SW3-B.
Distorted triangle and sine waveforms at one particular frequency range	1. Check for defective timing capacitor of the range (C15 thru C23). 2. Check C8 thru C10, C13, C25 and C94, if distortion shown at X 1 MHz range.
Distorted waveform or generator not running when X .001 Hz thru X 10 Hz selected	Capacitance multiplier malfunction.
Sine distortion out of specification at frequency below 500 kHz	1. Square wave time symmetry is not calibrated correctly. 2. Defective component in sine converter and square shaper. *NOTE* *If a diode is bad, the entire set of eight diodes should be replaced with a new matched set, or select a diode that gives minimum sine distortion at 1 kHz.* 3. Resistor R109, R111, R112 or R114 is out of tolerance. Connect 10 kΩ trim potentiometers in locations marked R111 and R112. Adjust the two trim potentiometers and also R68 and R71 to obtain less than 0.16% distortion. Remove the potentiometers, measure the resistance and replace with standard 1/8W resistors. If 0.16% distortion still cannot be achieved, remove both R110 and R113 and connect a 500Ω trim potentiometer in each location. Adjust the two trim potentiometers R68 and R71 for less than 0.16% distortion. Replace potentiometers with standard 1/8W resistors. 4. If sine distortion is OK at 1 kHz, but out of specification at 10 kHz, check for defective C31, C32, C38, Q6 and Q14.

Table 6-1. Troubleshooting Guide (Continued)

Symptom	Corrective Procedures
Sine distortion out of specification at frequency greater than 500 k Hz	1. Check square wave for slow rise/fall time. If so, check for defective capacitor in the preamplifier and output amplifier. 2. Frequency dial accuracy and sine distortion problems at X 1M range are due to the excess peaking or roll-off of the triangle waveform. Capacitors C28 and C35, also C29 and C34, need to be selected for maximum flatness of the triangle peak voltages at emitter of Q19. To check the flatness of the triangle peak voltage, a high frequency oscilloscope and a X 10 scope probe (> 150 MHz bandwidth) should be used. The oscilloscope probe should be correctly compensated and its ground lead length should keep to minimum. 3. If triangle is distorted, check for defective capacitors C8 thru C10, C13, C25 and C94. 4. Check for defective diodes CR10 or CR11.
TIME SYMMETRY PROBLEM	
Positive slope of triangle remains constant when frequency dial varied	1. Defective Q5, Q6, C9, IC3 and associated circuitry. 2. Defective Q9 thru Q12 and CR6 thru CR9.
Negative slope of triangle remains constant when frequency dial varied	1. Defective IC3 and associated circuitry. 2. Defective Q9 thru Q12 and CR6 thru CR9.
Symmetry cannot be adjusted to specification	Defective Q6, Q14, R33, R34, R40 and R41.
Symmetry worse at low frequency end of dial	Check for high leakage components Q6, Q9 thru Q12 and Q14.
Symmetry out of specification at X 10 frequency range or below	Defective IC6 and associated circuitry.
FREQUENCY ACCURACY PROBLEM	
Frequency accuracy out of specification at X 1 kHz range	1. Mismatched dial and potentiometer, if frequency is out of specification at the same portion of the dial in every range. Ensure that the number or the back of the dial matches the number on the potentiometer. 2. Defective dial potentiometer. 3. VCG amplifier (IC2) or current source (IC3) is saturated when frequency dial is set to the top (5.0). Check for defective Q1, Q6, IC2 and associated circuitry.
Frequency accuracy out of specification at X 10K and X 100 kHz ranges	Check for defective C30 thru C33, C38 and R61 thru R66.
Frequency accuracy out of specification at X 1 MHz range	Check for defective C25, C28, C29, C34, C35, R60, R67, CR10 and CR11.

Table 6-1. Troubleshooting Guide (Continued)

Symptom	Corrective Procedures
Frequency accuracy out of specification at X .001 to X 10 Hz ranges	1. R90 and R94 thru R96 are mismatched. Defective R97. 2. Defective IC5, IC6 and associated circuitry. 3. If triangle is distorted when dial is set to the top (5.0), defective regulator Q22 and Q23.
MODE OF OPERATION PROBLEM	
Output not in agreement with GEN MODE switch setting	Trigger and gate logic circuit or IC8 malfunction.
Generator running in trigger or gated mode	If voltage at pin 11 of IC8 is 0 to 0.4V (logic zero) when TRIG mode is selected, the problem is in the trigger amplifier (Q42 thru Q45). Otherwise, troubleshoot IC8, IC9 and associated circuitry.
Generator can be triggered by operating MAN TRIG switch, but not by external signal	Squaring circuit malfunction.
FREQUENCY SWEEP PROBLEM (All components on sweep board)	
Generator frequency not sweeping; no ramp signal at SWP OUT (GEN MODE at SWEEP, SWEEP MODE at CONT SWEEP)	1. If IC1 pins 2 and 3 do not have same voltage level, the buffer amplifier (IC1 and Q6) is bad. 2. Comparator flip-flop (Q7 thru Q10) is bad. 3. Log current source (Q3 thru Q5) is bad.

SECTION 7
PARTS AND SCHEMATICS

7.1 DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

7.2 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, board, serial number of unit, and if applicable, the function performed.

7.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

	Drawing No.
CHASSIS	
Schematic	0004-00-0054
Assembly Drawing	0102-00-0313
Parts List	1101-00-0056
MAIN BOARD	
Schematic	0103-00-0126
Assembly Drawing	0101-00-0126
Parts List	1100-00-0128
SWEEP BOARD	
Schematic	0103-00-0123
Assembly Drawing	0101-00-0123
Parts List	1100-00-0123

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A	REVISED PER ENG. NOTE UP		
9	ECN 1719		
	ADD T UPDATE		

FRONT PANEL

VCG IN — E73
GCV OUT — E72
PULSE OUT — E71
TRIG IN — E70
50Ω OUT — E69
SWP STOP R1 5K — E29
SWP START R8 5K — E30
I1 — E55
I2 185 ONLY — E56
R227 10 9W — E57
R226 220Ω 2W — E45
E50 — E74
E48
E42
E15
E43
E 5
E 7
E100
E60

MAIN BD.

E2
E3
E1
E14
E15
E13
GRN/YEL

REAR PANEL

P1 J3
E100 — 1
E101 — 2
E102 — 3
E103 — 4
E104 — 5
E105 — 6
E36 — 7
E67 — 8
E110 — 9

P3 J3
E73 E68 E72 E66 E70 E67 E69 E71
J1 P1
1 2 3 4 5 6 7 8

SWP OUT — E1, E2

SWEEP BD

I3 W85 ONLY

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	BA		WAVETEK
MATERIAL			SCHEMATIC
FINISH WAVETEK PROCESS			
			DWG NO. RA 185 2004
			23338

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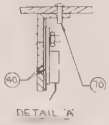

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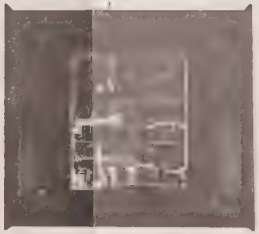

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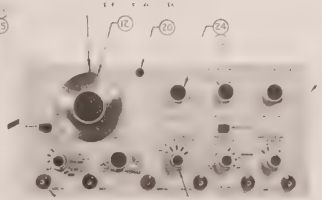
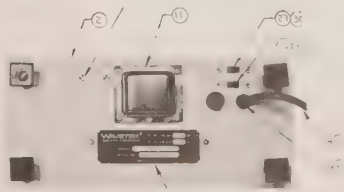
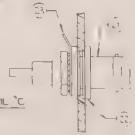


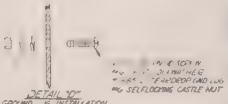
J2 DETAIL

— SEE DETAIL "D"





DETAIL "C"



DETAIL "D"
GROUND J5 INSTALLATION
(2 PLACES)

⚠ ALL CONNECTIONS TO BE MECHANICALLY SECURE TO LUGS PRIOR TO SOLDERING GROUND WIRES

NOTE UNLESS OTHERWISE SPECIFIED

A	ECR 1719	00/MAR	

WAVETEK

HARDWARE ASSEMBLY

DO NOT SCALE DRAWING

SCALE

184 183

23338

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION OPERATION AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION

NONE	ASSY DRND CHASSIS	0102-00-0313	MVTK	1
NONE	DIAL ASSY	183-025	MVTK	1
NONE	TRANSFORMER	5600-00-0022	MVTK	1
NONE	END BELL	110-233	MVTK	1
NONE	PLATE NAME	124-205	MVTK	1
NONE	INDICATOR DIAL	100-303	MVTK	1
NONE	[illegible]	[illegible]	MVTK	1
NONE	EXPANDER	180-301	MVTK	2
NONE	POST	180-302	MVTK	4
NONE	COVER BOTTOM	180-300-2	MVTK	1
NONE	PANEL REAR	182-201	MVTK	1
NONE	CORD HOLDER	1400-00-5409	MVTK	1
NONE	PANEL FT	1400-00-8730	MVTK	1
NONE	I.D. LABEL	1400-00-9110	MVTK	1
NONE	SW CONN	MC-7946	MTK.	6
NONE	SOLDER LUG	1497	SMITH	6
NONE	SOLDER LUG	1483-6	SMITH	4
NONE	CONN	60398-8	AMP	2

WAVETEK PARTS LIST — TITLE: STD CHASSIS — ASSEMBLY NO. 1101-00-0156 — REV B — PAGE 1

NONE	PWR CORD	[illegible]	[illegible]

WAVETEK PARTS LIST — TITLE: STD CHASSIS — ASSEMBLY NO. [illegible] — REV B — PAGE [illegible]

REFERENCE SYMBOL(S)	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/ASY
NONE	STD KNOB	RS-a7-1-SB-M	RGNY	2400-01-0008	4
NONE	COAX KNOB SET	RS-a7-1-SB+0-M-9	RGNY	2400-01-0009	4
NONE	LAMP	CM7-787a	CMPN	2400-02-0013	1
NONE	FUSE 1 4A 250V S-B	313.250	LITU	2400-05-0008	1
NONE	FUSE HOLD	031.1652.031.1666	SCHU	2400-05-0012	1
NONE	BUSHING NYLINER	4L2FF	TNDH	2800-01-0002	8
NONE	STANDOFF MALE FEMALE 4-.375 H-.250 HEX	1475-M03-F03-832	UNIF	2890-02-0010	4
NONE	STANDOFF MALE FEMALE 4-.375 H-.250 HEX	1495-M03-F03-440	UNIF	2890-02-0011	4
NONE	BAIL ASSY W/FT	180-500	WVTK	2930-08-0010	1
NONE	SPEEDNUT SELF RETAIN	C7494-632-4	TENN	2930-09-0003	6
NONE	WASHER SHOULDER	2aaB	SMTH	2890-27-0004	12
NONE	STRAIN RELIEF BUSH	SRaH-1	HEY	2890-37-0003	1
NONE	SW ASSY SLIDE HI-LO	Ca422-FT-HA	UTD	5105-00-0001	1
NONE	SWITCH ASSY SLIDE	4a296-LF	SWCT	5105-00-0002	1
NONE	SOLDER BOARD	4a296 LF-SB	SWCT	5.09-09-0001	2

WAVETEK PARTS LIST — TITLE: STD CHASSIS — ASSEMBLY NO. 1101-00-0156 — REV B — PAGE 2

NOTE: UNLESS OTHERWISE SPECIFIED

WAVETEK — PARTS LIST — ASSY — 1101-0-0156 — SCALE: NONE — SIZE: D — 23338

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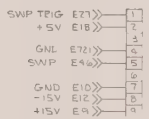
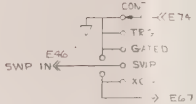
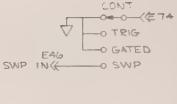


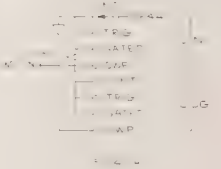
P1 TO SWEEP BD
ALL MODELS



SW4 - A



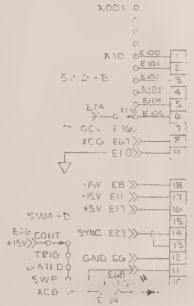
SW4 - A



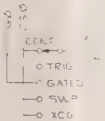
GEN MODE SWITCH
MODEL 183

GEN MODE SWITCH
MODEL 184

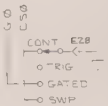
GEN MODE SWITCH
MODEL 185



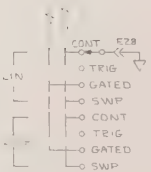
CONNECTORS TO XCG BD
183 ONLY



SW4-C



SW4-C



SW4-C

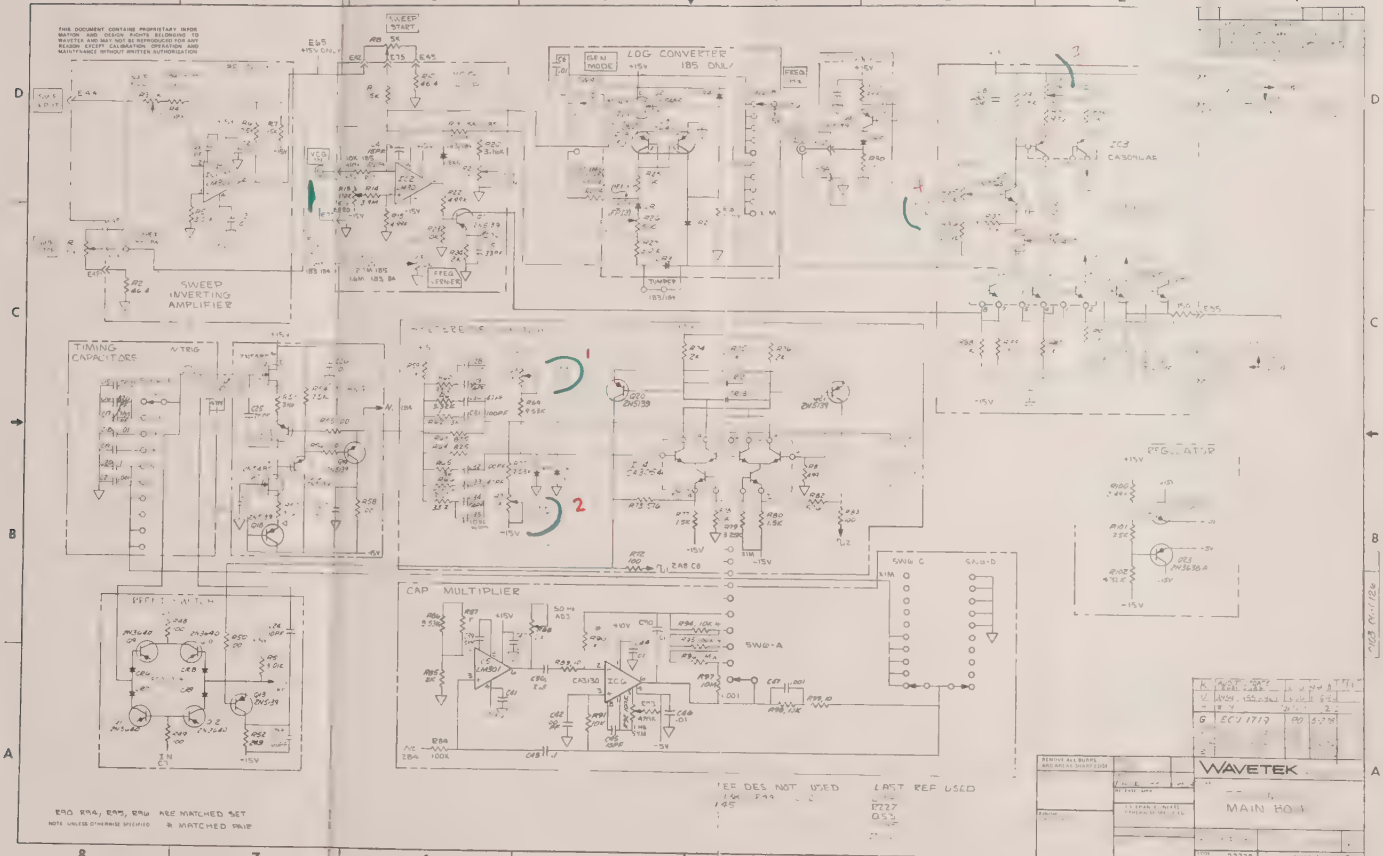
NOTE: UNLESS OTHERWISE SPECIFIED

WAVETEK

SCHEMATIC
MAIN BOARD

FS 84 185 | 0103-0126 | A

23378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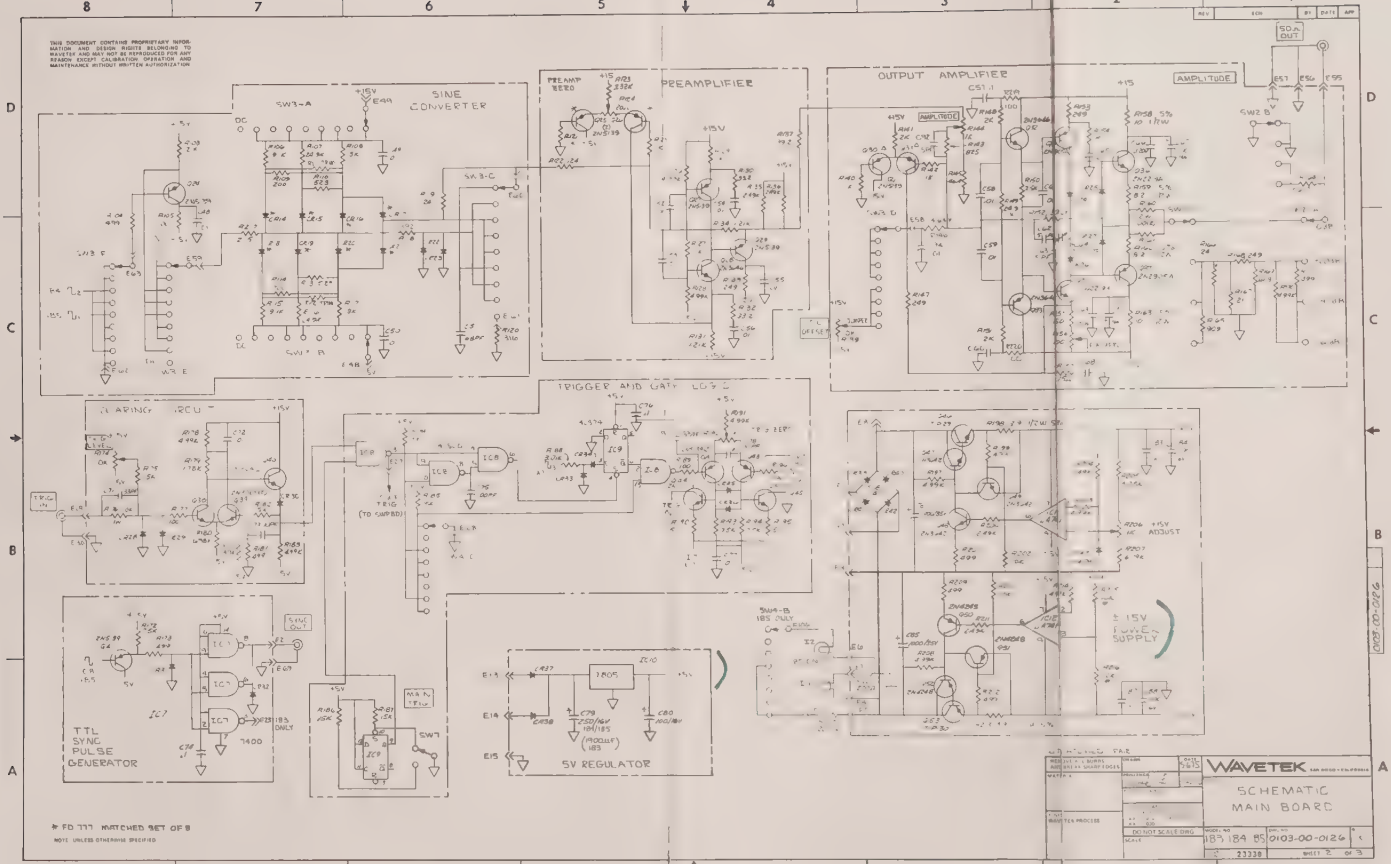
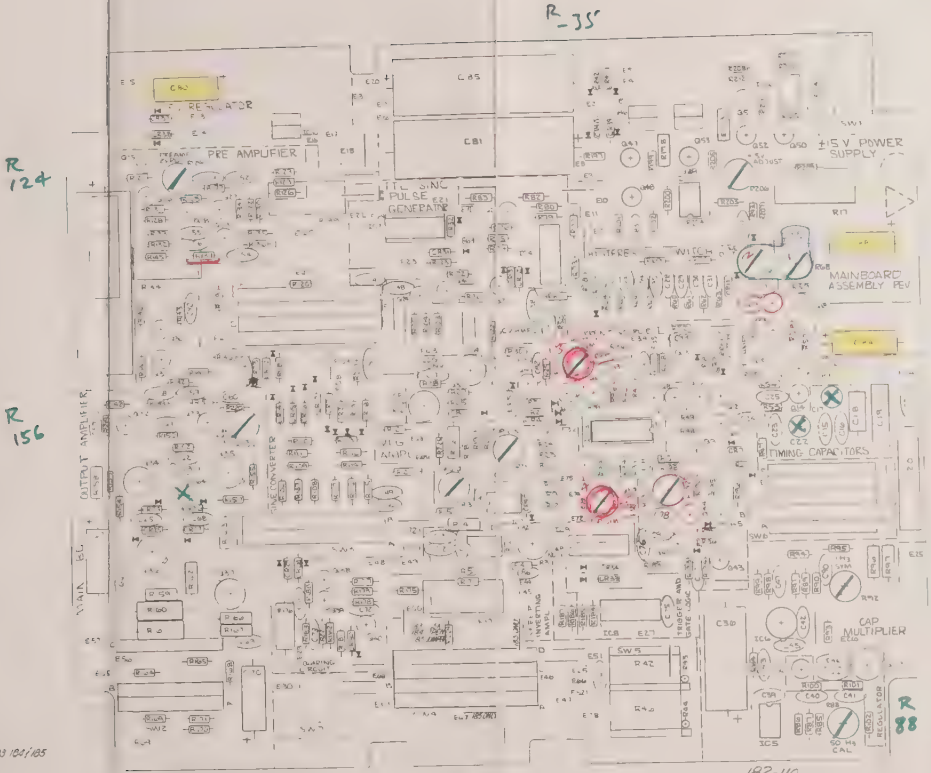
SWEEP START
LOG CONVERTER
SWEEP INVERTING AMPLIFIER
TIMING CAPACITORS
CAP MULTIPLIER
REGULATOR
MAIN BOARD
WAVETEK
R80, R84, R85, R86 ARE MATCHED SET
NOTE UNLESS OTHERWISE SPECIFIED R MATCHED PAIR
LAST REF USED
REF DES NOT USED


SINE CONVERTER
PREAMPLIFIER
OUTPUT AMPLIFIER
AMPLITUDE
SQA OUT
TRIGGER AND GATE LOGIC
CLAMPING CIRCUIT
TTL SYNC PULSE GENERATOR
7400
5V REGULATOR
7805
±15V POWER SUPPLY
SCHEMATIC
MAIN BOARD
WAVETEK
0103-00-0126
0103-00-026
* FD 777 MATCHED SET OF 8
NOTE UNLESS OTHERWISE SPECIFIED

E721 WAS E72
E481 " E48
E521 " E52
E111 WAS E9
E110 ADDED TO
HOLE UNDER E721

REV	DESCRIPTION	BY	DATE
A	PC LAYOUT PER ECN 1420		
B			
C	ECN 1420 / 1420	RD	6-4-73
D	ECN 1719	RD	6-28
E	ECN 2107		
F	ECN 2294, 2371 & V 652		3-8



R 124
R 206
R 71
R 68
Q 1
R 156
R 92
R 88
R 13
R 21
R-32
R 192

3 CR3 IS JUMPER IN MODELS 183, 184

2. SOLDER R227 AT E7 LOCATION ON 183 104/185
ADD R226 AT E111 ON MODEL 185

1. 9 PIN MOLEX TO CRYSTAL BD TO BE WIRED BACKWARDS SO THAT BROWN WIRE IS PIN 9 AND WHITE WIRE IS PIN 1

DRAWN BY	DATE 3-1-73	WAVETEK	
ENGINEER		TITLE	
RELEASE APPROV.		SILKSCREEN ASSEMBLY PRINT (MAIN BOARD)	
		MODEL NO. 183, 184, 185	DWG NO. 904-001-026 REV F
SHT 1 OF 1		SIZE B	

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REV	ECN	BY	DATE	APP

⚠ ADD SHRINK SLEEVE TO SWITCH POT (R194) SHAFT. TO PREVENT SHORTING.

(5104-07-0003) ADDED STOP

FIXED STOP

SW2
5104-99-0004
(MADE FROM 5104-01-0003)

SW2-A
5104-02-0013

SW2-B
5104-02-0013

SW PLATE
1400-00-2130

SW2-C
5104-02-0013

TABS TYP ALL 41-44 WAFERS

FIXED STOP

(5104-07-0003) ADDED STOP

SW3
5104-99-0004
(MADE FROM 5104-01-0007)

SW3-A
5104-02-0015

SW3-B
5104-02-0015

SW PLATE
1400-00-2130

SW3-C
5104-02-0013

SW3-D
5104-02-0015

SW3-E
5104-02-0015

SW3-F
5104-02-0015

MODEL 185 ONLY

MODEL 184 ONLY

MODEL 183 ONLY

FIXED STOP

ADDED STOP (5104-07-0003)

SW4
5104-99-0016
(MADE FROM 5104-99-0042)

(5104-07-0003) ADDED STOP

FIXED STOP

SW4
5104-99-0015
(MADE FROM 5104-99-0042)

FIXED STOP

ADDED STOP (5104-07-0003)

SW4

SW4-A
5104-02-0015

SW4-B
5104-02-0015

SW4-C
5104-02-0015

SW4-D
5104-02-0015

SWITCH PLATE
1400-00-2130

NUMBERS ON TAB INDICATE WIRE COLOR
MODEL 183 ONLY

DETAIL A

SW6
5104-99-0023
(MADE FROM 5104-01-0007)

SW6-A
5104-02-0013

185 ONLY

SW6-B
5104-02-0015
(182 - SW1-1
184 - ONLY)

SW6-C
5104-02-0013

SW6-D
5104-02-0008

SW6-E
5104-02-0013

SW PLATE
1400-00-2130

SW6-B
T105

⚠ ADD SWITCH PLATE AS SHOWN (4 PLACES) SEE DETAIL 'A'

⚠ ADD SHRINK SLEEVING TO POT SHAFT" (SW2)

2 DETENTS & WAFERS ARE THE SAME FOR ALL MODELS EXCEPT AS INDICATED

1 ALL DETENTS & WAFERS ARE SHOWN FROM FRONT VIEW IN FULL COUNTER CLOCKWISE POSITION.

NOTE UNLESS OTHERWISE SPECIFIED

DRAWN			WAVETEK San Diego, California
MFG. APPROV.			
ENG. APPROV.			
TOLERANCE UNLESS OTHERWISE SPECIFIED XX ± .02 XXX ± .010 ANGLES ± 1°			SWITCH DWG MAIN BOARD
DO NOT SCALE DWG	MODEL NO. 8 84 - 85	DWG NO. 0101-00-0126	REV. F
	SCALE 2/3338	SHEET 2 OF 2	

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NONE	ASSY, BRKD MAIN	0101-00-0126	WVTK	0101-00-0126	1
NONE	SCHEMATIC MAIN	0103-00-0126	WVTK	0103-00-0126	1
NONE	P.C. BRKD MAIN	0107-00-0126	WVTK	0107-00-0126	1
NONE	BRKT	133-305	WVTK	1400-00-1673	1
NONE	PLATE, SW	008-004	WVTK	1400-00-2130	1
183	SPRING PART OF 3200-01-0001	147-383	WVTK	1400-00-3750	1
	BRKT HEAT SINK	182-308	WVTK	1400-00-5143	2
	HDR POWER	182-309	WVTK	1400-00-5150	1
	BKT POWER HDR	182-310	WVTK	1400-00-5160	2
C63 C82	CAP CER 5PF 1KV	DD-050	CRL	1500-00-5011	4
C357 C75 C78	CAP CER 100PF 1KV	DD-100	CRL	1500-01-0011	5
C42 C75 C83	CAP CER 150PF 1KV	DD-101	CRL	1500-01-0111	5
C31 C38 C47	CAP CER .001MF 1KV	DD-102	ARCJ	1500-01-0211	5
C37 C45 C60 C64 C66 C69 C70 C74 C84 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100 C101 C102 C103 C104 C105 C106 C107 C108	CAP CER .01MF 50V	CK-102	CRL	1500-01-0310	32
C60 C66 C67	CAP CER .1MF 20V	JK20-104	CRL	1500-01-0413	7

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0126 — REV F — PAGE 1

C4 C33	CAP CER 15PF 1KV	DD-150	ARCJ	1500-01-3011	2
C257	CAP CER 22PF 1KV	DD-220	ARC	1500-02-2011	1
C5 C7 C91	CAP CER 33PF 1KV	DD-330	CRL	1500-03-3011	3
C14 C20 C23	CAP CER 47PF 1KV	DD-470	ARCJ	1500-04-7011	3
C24 C26	CAP CER 56PF 1KV	DD-560	ARCJ	1500-05-6001	2
C51	CAP CER 68PF 1KV	DD-680	CRL	1500-06-8011	1
C8	CAP CER 680PF 1KV	DD-681	ARCJ	1500-06-8111	1
C25	CAP MICA 47PF 500V	DM15-470J	ARCJ	1500-14-7200	1
C15	CAP MICA 82PF 500V	DM15-820J	ARCJ	1500-18-2000	1
C10	CAP MICA 820PF 500V	DM15-821F	ARCJ	1500-18-2101	1
C70 C80 C84 C88	CAP ELECT 100MF 16V	50001075016DE7	SPRAG	1500-31-0101	5
C1 C95	CAP ELECT 1000MF 35V	39D108G035GL6	SPRAG	1500-31-0212	2
C9	CAP ELECT 250MF 16V	30022579016DF7	SPRAG	1500-32-5101	1
C36	CAP, MYLR 2MF 200V	2MF420M	AMRAD	1500-42-0504	1
C64	VARI 3.5-13PF 250V	TS-TRIAD-G2 3.5/13PF	TRIAD	1500-51-3000	1
C17 C22	VARI 7-35PF 250V	TS-TRIAD-G2 7/35 PF	TRIAD	1500-53-5000	2

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0126 — REV F — PAGE 2

R144	POT CONT 1K	91-401	WVTK	4600-01-0307	1
R192 R206 R21 R62 R71	POT TRIM 1K	91-401R	BECK	4600-01-0209	5
R138 R17	POT CONT 10K	91-401	WVTK	4600-01-0312	2
R13 R35 R92	POT TRIM 100K	91-401100K	BECK	4600-01-0402	3
R124	POT TRIM 20	91-401R20	BECK	4600-02-0090	1
R88	POT TRIM 2K	91-401R2K	BECK	4600-02-0201	1
SW3	POT SWITCH 20K	91-401 20K	WVTK	4602-02-0302	1
R174	POT CONT 10K WITH 4600-71-0203	91-401-71-0313	WVTK	4609-71-0313	1
R158 R163	RES C 1/2W 5% 10	RC20GF 100	STAP	4700-25-0100	2
R190 R213	RES C 1/2W 5% 3.9	RC20GF-3R9	STAP	4700-25-0399	2
R159 R162	RES C 1/2W 5% 8.2	RC20GF-8R2	STAP	4700-25-0829	2
R49	RES C 1/2W 5% 10M	RC20GF 106	STAP	4700-25-1005	1
R44	RES C 1/2W 5% 1.6M	RC20GF-165	STAP	4700-25-1604	1
R227	RES C 1/2W 5% 220	RC20GF-221	STAP	4700-25-2200	1
R14	RES C 1/2W 5% 3.9M	RC20GF-395	STAP	4700 25-3904	1
R176	RES C 1W 10% 10K	RC32GF-103	STAP	4700-35-1002	1
R105 R177 R187 R196	RES MF 1/8W 1% 100	RN55D-1000F	TRW	4701-03-1000	14

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0126 — REV F — PAGE 4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFR/PART NO	MFGR	WAVETEK NO.	QTY/BD
R219 R220 R48 R49 R50 R55 R56 R58 R72 R83	RES MF 1/8W 1% 1K	RN55D-1001F	TRW	4701-03-1001	12
R121 R125 R140 R142 R20 R24 R38 R39 R40 R41 R59 R71					
R127 R172 R210 R23 R91	RES MF 1/8W 1% 10K	RN55D-1002F	TRW	4701-03-1002	9
R84	RES MF 1/8W 1% 100K	RN55D-1003F	TRW	4701-03-1003	1
R47 R80 R89	RES MF 1/8W 1% 10	RN55D-1080F	TRW	4701-03-1009	3
R98	RES MF 1/8W 1% 1.1K	RN55D-1101F	TRW	4701-03-1101	1
R131 R134	RES MF 1/8W 1% 1.21K	RN55D-1211F	TRW	4701-03-1211	2
R119 R122	RES MF 1/8W 1% 124	RN55D-1240F	TRW	4701 03-1240	2
R108 R117 R42 R65	RES MF 1/8W 1% 13K	RN55D-1302F	TRW	4701-03-1302	4
R155	RES MF 1/8W 1% 150	RN55D-1500F	TRW	4701-03-1500	1
R102 R200 R31 R77 R78 R80	RES MF 1/8W 1% 1.5K	RN55D-1501F	TRW	4701-03-1501	6
R11 R175 R184 R185 R186 R187 R37	RES MF 1/8W 1% 13K	RN55D-1302F	TRW	4701-03-1302	7
R154 R157	RES MF 1/8W 1% 19	RN55D-1909F	TRW	4701 03-1909	2
R179	RES MF 1/8W 1% 1.78K	RN55D-1781F	TRW	4701-03-1781	1
R106 R115	RES MF 1/8W 1% 19.1K	RN55D-1912F	TRW	4701 03-1912	2

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0126 — REV F — PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFR/PART NO	MFGR	WAVETEK NO.	QTY/BD
R109 R114	RES MF 1/8W 1% 200	RN55D-2000F	TRW	4701-03-2000	4
R103 R129 R141 R148 R151 R24 R74 R76 R85	RES MF 1/8W 1% 2K	RN55D-2001F	TRW	4701-03-2001	9
R217	RES MF 1/8W 1% 21.5K	RN55D-2152F	TRW	4701-03-2152	1
R133 R147 R153 R168 R52	RES MF 1/8W 1% 249	RN55D-2490F	TRW	4701-03-2490	5
R100 R135 R136 R200 R204 R211	RES MF 1/8W 1% 2.49K	RN55D-2491F	TRW	4701-03-2491	6
R107 R116 R149 R221 R36	RES MF 1/8W 1% 24.9K	RN55D-2492F	TRW	4701-03-2492	5
R180 R31	RES MF 1/8W 1% 3.01K	RN55D-3011F	TRW	4701-03-3011	2
R120 R53 R57	RES MF 1/8W 1% 316	RN55D-3160F	TRW	4701-03-3160	3
R20	RES MF 1/8W 1% 3.16K	RN55D-3161F	TRW	4701-03-3161	1
R123 R152 R61 R66	RES MF 1/8W 1% 3.32K	RN55D-3321F	TRW	4701-03-3321	4
R120 R132 R60 R67	RES MF 1/8W 1% 33.2	RN55D-33R2F	TRW	4701-03-33R2	4
R110	RES MF 1/8W 1% 392	RN55D-3920F	TRW	4701-03-3920	1
R137	RES MF 1/8W 1% 39.2	RN55D-39R2F	TRW	4701-03-39R2	1
R87	RES MF 1/8W 1% 40.2K	RN55D-4022F	TRW	4701 03-4022	1
R103	RES MF 1/8W 1% 4.32K	RN55D-4321F	TRW	4701-03-4321	1

WAVETEK PARTS LIST — TITLE MAIN — ASSEMBLY NO 1100-00-0126 — REV F — PAGE 5

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES — MATERIAL — FINISH — DO NOT SCALE DRAWING — DRAWN — DESIGNED — RELEASE APPROV — TOLERANCES UNLESS OTHERWISE SPECIFIED: .XX ± .02, .XXX ± .005, ANGLES ± 1° — DO NOT MANUALLY CHANGE — DATE

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PARTS LIST MAIN BOARD

SIZE: B — DWG NO: 1100-00-0126 — REV: F — SCALE: NONE — WEIGHT: — SHEET 1 OF 2

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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR-PART-NO	MFGR	WAVETEK NO	QTY
R140 R9	RES MF 1 8W 1% 8.66K	RN550-4466F	TRW	4701-03-4466	2
R141 R143	RES MF 1 8W 1% 86.6	RN550-4864F	TRW	4701-03-8664	.
R142 R144 R1 R145 R146 R147 R148 R149	RES MF 1 8 1% 499	RN550-4990F	TRW	4701-03-4990	10
R1001	RES MF 1 8W 1% 8.06K	RN550-8061F	TRW	4701-03-8061	1
R1002 R1003 R1004 R1005 R1006 R1007	RES MF 1 8W 1% 75.0K	RN550-7502F	TRW	4701-03-7502	6

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR-PART-NO	MFGR	WAVETEK NO	QTY
	RES NF MIXED SET			4700-00-0038	
R1 R2 R3 R4 R5 R6 R7 R8	RES NET 8 PIN 2.2K 2%	8300E	BOURNS	4631-02-0222	8

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR-PART-NO	MFGR	WAVETEK NO	QTY

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR-PART-NO	MFGR	WAVETEK NO	QTY
R100 R101	RES MF 1 4W 1% 100	RN60E-1000F	TRW	4701-23-0100	2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR-PART-NO	MFGR	WAVETEK NO	QTY

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR-PART-NO	MFGR	WAVETEK NO	QTY

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG MFGR-PART-NO	MFGR	WAVETEK NO	QTY

WAVETEK PARTS LIST

WAVETEK PARTS LIST

WAVETEK PARTS LIST

WAVETEK PARTS LIST

WAVETEK PARTS LIST

WAVETEK PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES

MATERIAL

FINISH WAVETEK PREFINISH

DRAWN

PROVIDED

RELEASE APPROVED

TOLERANCE UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DWG

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PARTS LIST MAIN BOARD

MODEL NO: 184

DWG NO: 1184-00-0128

REV: F

SIZE: D

SCALE: 22338

SHEET 2 OF 2

NOTE UNLESS OTHERWISE SPECIFIED

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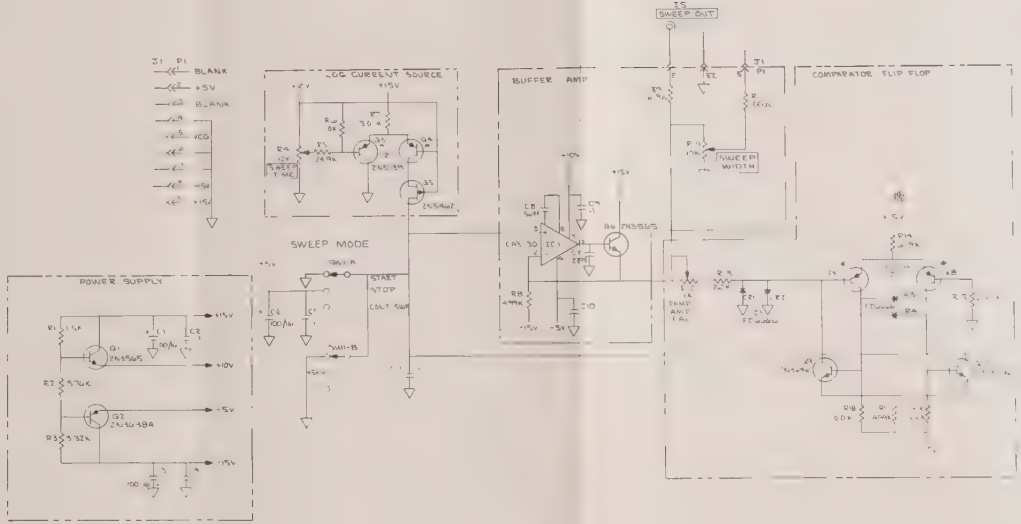
REASON EXCEPT CALIBRATION OPERATION AND
MAINTENANCE WITHOUT WRITTEN AUTHORIZATION



1 % MATCHED PAIR

NOTE UNLESS OTHERWISE SPECIFIED

LAST DES USED
R18
CR4
Q10
IC1
SW1

WAVETEK

SCHEMATIC
SWEEP BOARD

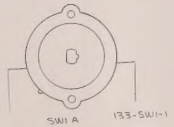
DO NOT SCALE DWG
SCALE

183 - 184

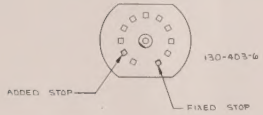
003-00-0123

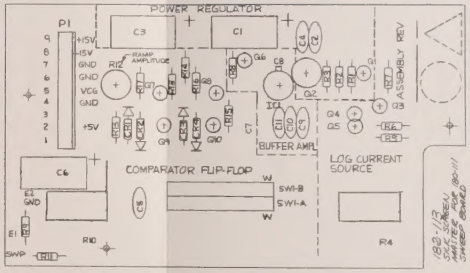
A

22338



DETENT SHOWN FROM FRONT IN FULL COUNTER-CLOCKWISE POSITION





DRAWN BA	DATE 4-24-75	WAVETEK SAN DIEGO, CALIF.	
ENGR		TITLE	
RELEASE APPROV		SILKSCREEN ASSEMBLY PRINT (SWEEP PC)	
TOLERANCE			
SCALE		MODEL NO. 183-124	DWG. NO. 0101-00-0123 REV. A
		53338	SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY, DRWG SWEEP	0101-00-0123	WVTK	0101-00-0123	1
NONE	SCHEMATIC SWEEP	0103-00-0123	WVTK	0103-00-0123	1
NONE	QA ASSY DRWG SWEEP	0107-00-0123	WVTK	0107-00-0123	1
NONE	PLATE, SW	008-004	WVTK	1400-03-2130	2
C10 C2 C4 C5 C9	CAP, CER., 1MF, 20V	UK20-104	CRL	1500-01-0413	5
C11	CAP, CER, 22PF, 1KV	DD-220	ARCO	1500-02-2011	1
C8	CAP, CER, 36PF, 1KV	DD-360	ARCO	1500-05-6003	1
C1 C3 C6	CAP, ELECT, 100MF, 16V	500D107G016DL7	SPRG	1500-31-0101	3
C7	CAP, FOIL E., 1MF, 100V	225P1049WD3	SPRG	1500-41-0484	1
NONE	SWEEP	182-111	WVTK	1700-00-0123	1
NONE	CONN, SPIN	09-60-1091	MOLX	2190-02-0092	1
NONE	PIN MALE	61182-2	AMP	2190-05-0020	2
NONE	STANDOFF SWAGE .625 M., .250 HEX, 6-32, .062 MAT'L	15218-5/8	USEC	2800-02-0004	3
NONE	TRANSPAC	10123M	METX	2800-11-0003	1
R12	POT, TRIM, 1K	91A81K	BECK	4400-01-0209	1
R10 R4	POT, CONT, 10K	JM-1304	CTS	4400-31-0303	2
R11	RES, MF, 1/8W, 1%, 100	RN55D-1000F	TRW	4701-03-1000	1

WAVETEK PARTS LIST — TITLE: SWEEP — ASSEMBLY NO: 1100-00-0123 — PAGE 1 — REV: B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
S3 S4 S7 S8	TRANS M/FR, 2PST, GTI, 2 4901-05-1390	164-301-80	WSTL	4998-00-0015	2
S5 S6 S9	WAFER	133-541-1	WSTL	5104-02-0008	2
NONE	SWITCH STOP	212-23-004	TYC	5104-02-0004	1
NONE	DETENT, NOT FROM 5104-31-0002	5104-99-0042	WSTL	5104-99-0042	1
IC1	IC	CA-3130	RCA	7000-31-0000	1

WAVETEK PARTS LIST — TITLE: SWEEP — ASSEMBLY NO: 1100-00-0123 — PAGE 1 — REV: B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R6	RES, MF, 1/8W, 5%, 1K	RN55D-1001F	TRW	4701-03-1001	1
R13 R18	RES, MF, 1/8W, 1%, 10K	RN55D-1002F	TRW	4701-03-1002	2
R1	RES, MF, 1/8W, 1%, 1.5K	RN55D-1501F	TRW	4701-03-1501	1
R15	RES, MF, 1/8W, 1%, 2K	RN55D-2001F	TRW	4701-03-2001	1
R16	RES, MF, 1/8W, 1%, 2,49	RN55D-2491F	TRW	4701-03-2491	1
R5	RES, MF, 1/8W, 1%, 24,9K	RN55D-2492F	TRW	4701-03-2492	1
R7	RES, MF, 1/8W, 1%, 3,01K	RN55D-3011F	TRW	4701-03-3011	1
R3	RES, MF, 1/8W, 1%, 3,32K	RN55D-3321F	TRW	4701-03-3321	1
R17 R3	RES, MF 1/8W, 1%, 4,99K	RN55D-4991F	TRW	4701-03-4991	2
R2	RES, MF, 1/8W, 1%, 5,76K	RN55D-5761F	TRW	4701-03-5761	1
R9	RES, MF, 1/8W, 1%, 619	RN55D-6190F	TRW	4701-03-6190	1
R14	RES, MF, 1/8W, 1%, 6,19K	RN55D-6191F	TRW	4701-03-6191	1
CR1 CR2 CR3 CR4	DIODE	FD-6666	FAIR	4807-02-6666	4
Q1 Q6	TRANS	2N3565	FAIR	4901-03-3650	2
Q2	TRANS	2N3638A	CARR	4901-03-6391	1
Q10 Q7	TRANS	2N3646	MOT	4901-03-6460	2
Q5	TRANS	2N3462	MOT	4901-05-4620	1

WAVETEK PARTS LIST — TITLE: SWEEP — ASSEMBLY NO: 1100-00-0123 — PAGE 2 — REV: B

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	ENGR APPROV		TITLE: PARTS LIST SWEEP BOARD
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1° .XX ± .030		MODEL NO. 184 — DWG NO. 1100-00-0123 — REV. B
	DO NOT SCALE DWG		SCALE — SIZE B — CAGE CODE 23338 — SHEET 1 OF 1

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